

## 5.6

## Energy Management

Appropriate control systems allow facility managers to automate functions that would be impossible or impractical to control manually. Automatic controls are useful with lighting, air distribution systems, chillers, boilers, heat pumps, pumping systems, compressed air systems, water heating, and other major energy-consuming equipment. Controls may be simple and inexpensive, or complex and costly. Simple controls, including time clocks, occupancy sensors, photocells, and programmable thermostats, are discussed in this section. More sophisticated, computer-based energy management and control systems (EMCSs) that monitor hundreds or thousands of “points” throughout a facility are discussed in *Section 5.6.1*. Some control systems designed to reduce peak electrical demand and lower utility bills are covered in *Section 5.6.2 – Managing Utility Costs*. Most of the discussion on lighting controls is found in *Section 5.4.4*.



Power outages disrupt schedules of electromechanical time clocks because the time setting is lost; battery backup may be justified in locations with frequent loss of power. Daylight Savings Time shifts also require resetting of clocks.

## Opportunities

Facility managers should consider automatic controls and sensing technology when equipment can be turned on, shut off, or modulated based on schedules, temperatures, pressures, light levels, or the presence or absence of personnel. HVAC and lighting are prime candidates for automatic controls. It is easiest to add (or change) control systems when the HVAC or lighting systems are being replaced or modified in other ways, though controls can often be retrofit fairly easily.

## Technical Information

The following is general information about some of the common controls available to help reduce energy consumption.

**Time clocks** are electrical or electromechanical devices that can turn equipment on and off according to a schedule. Small loads can be switched directly, and large loads can be controlled indirectly through the use of relays. Many time clocks are 24-hour devices that repeat programs every day. Some have weekly and even annual wheels that allow more complex programming patterns. Although it will minimize wiring costs, locating time clocks near the circuits they control is not necessary. Maintenance staff must have easy access to controls to carry out preventive maintenance and to ensure that the control equipment is operating properly.

**Occupancy sensors** detect whether people are present by sensing heat (infrared), motion (ultrasonic), or sound. Some systems directly control small lighting loads at line voltage and directly replace wall switches.



Standard time clocks usually do a poor job of controlling exterior lights because they do not account for daily changes in sunset and sunrise.

Others are part of more complex systems that may include several sensors, control logic, and an interface to the load. Facilities that have EMCSs may also make use of occupancy sensors to control lights and certain HVAC operations.

**Programmable electronic thermostats** allow facility managers to reset heating and cooling setpoints for different operating modes. Daytime, nighttime, and weekends typically have different target temperatures in order to allow the building temperature to drift appropriately when unoccupied, then return automatically to occupied mode.

**Timers** are simple devices that automatically turn off loads after a predetermined number of minutes or hours. They can be used to control bathroom exhaust fans, for example, allowing moisture removal for a predetermined period of time after showering—thus eliminating the need for continuous operation. Timers are sometimes more cost-effective than occupancy sensors in controlling lighting and fan loads in areas that are used infrequently. These can either be mechanical, with spring-wound mechanisms, or electronic, with digital controls. The latter are quieter and can be programmed for different time-out periods.

**Photocells** are devices that open and close switches in response to light levels. Some photocells are not very sensitive to low light levels at dusk and dawn and may, for example, switch outdoor lights on in the evening before light is needed. This wastes energy and, in some cases, can increase demand charges. Photocells are also used to dim fluorescent lights inside buildings where electric light levels are regulated on the basis of available daylighting (see *Section 5.4.4 – Lighting Controls*).



To avoid injury, it is important to post signs indicating the control mechanism and to install disconnect switches near equipment operated by automatic controls.

**When purchasing programmable thermostats** made for use with heat pumps, ensure that they have “ramped recovery” features for heating. Ramped recovery slowly brings the building up to the target temperature without engaging the supplementary electric strip heating.

**Facility managers should document all the automatic controls in their facilities** by recording the locations of controls, the equipment being controlled, and any requirements for resetting the time or program as seasons change, as time changes for Daylight Savings, or after power outages.

**Electrically combining time clocks and photocells** may provide a good way to program the needed exterior lighting logic—for example, “on at sunset, off at 10:00 p.m.” Facilities with EMCS equipment should have no trouble implementing this type of control logic.



Sophisticated electronic controls, such as programmable thermostats and EMCSs, can be prone to problems with electrical power quality: surges, spikes, brownouts, and outages, particularly in locations distant from utility substations. Putting this equipment on circuits with surge suppression or uninterruptible power supply (UPS) may be advisable.